



## *U.S. Marine Corps Corrosion Prevention and Control (CPAC) Program Status*

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## USMC Operating Environment





# Marine Corps Order 4790.18B

## MISSION

To establish an effective CPAC program to extend the useful life of all Marine Corps tactical ground and ground support equipment

## OBJECTIVE

Mitigate the Impact of Corrosion on USMC Assets through a comprehensive CPAC Program

- **Existing Assets:** Treatment and Prevention
- **New Procurements:** Implementing corrosion control in the design stage
- **Research and Development / Engineering:** Better products and processes to combat corrosion

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## Existing Assets

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Corrosion Assessment  
Teams



Corrosion Rehabilitation  
Facility (CRF) – (C3)



Controlled Humidity Storage



Repair

Preserve

Protect



Corrosion Service Teams (CST)



VCI Covers



## Corrosion Assessments and Database - Corrosion Category Code Definitions

**Category 1** : Item requires no corrosion repair or preservatives, and has been assessed within the past 6 months. The goal at this level is to maintain the item as a category 1.

**Category 2**: Item requires surface preparation, spot paint, and preservation at the operator and/or organizational level. The goal of this effort should to return the item to category 1.

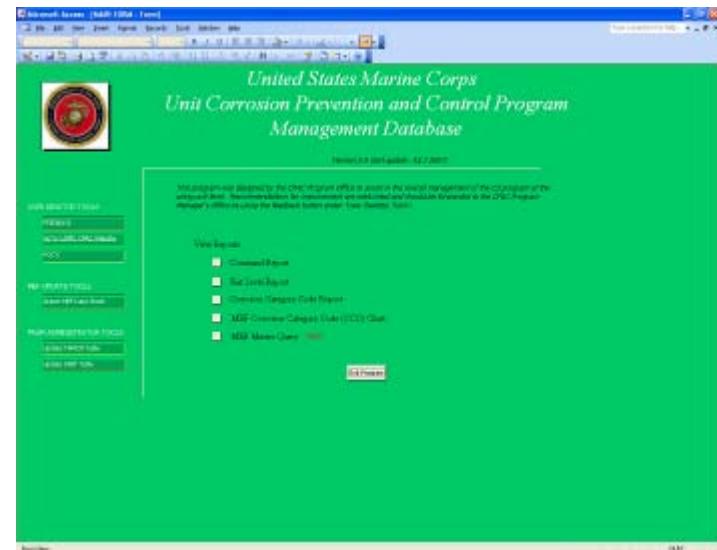
**Category 3**: Item requires maintenance performed beyond the operator level. Spot painting has arrested the corrosion, but the item is now in a condition that requires complete repainting and overcoat. The item must be inducted to the C3 program for repair. The goal of this effort is to induct the item into the C3 program so that it will return to the unit in a category 1 condition.

**Category 4**: Item requires repair to sheet metal, major frame components, paint, blasting and undercoating (e.g., replacement or repair of components such as doors, fenders, and chassis frame rails, or battery boxes due to corrosion). The goal of this effort is to immediately induct the item into the C3 program so that it will return to the unit in a category 1 condition.

**Category 5**: The item is degraded to a degree that requires depot level repair and replacement based on the deterioration caused by corrosion.



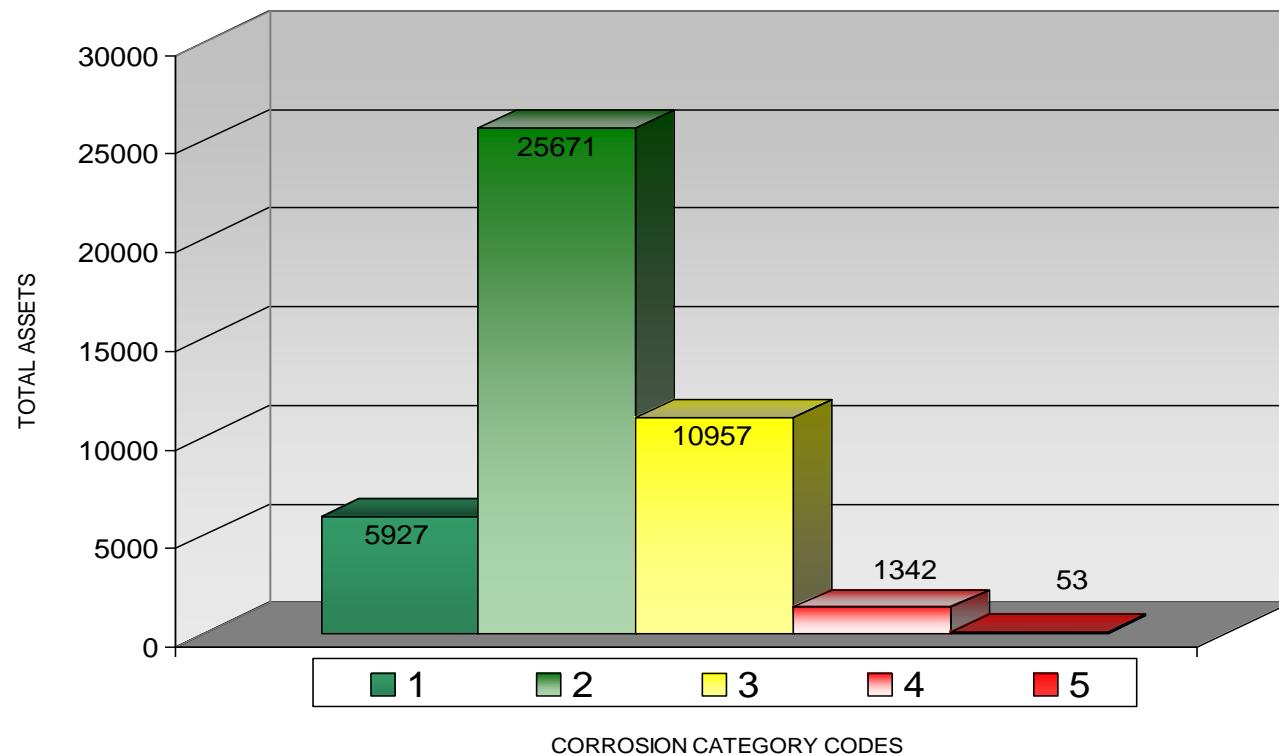
### Inspection Tool and Database



- Data is captured via handheld PDA and uploaded into CPAC database
- Database is updated weekly and reports are available from CPAC website
- Data is used to determine funding levels at each MEF



**USMC GROUND COMBAT AND SUPPORT EQUIPMENT  
CORROSION CATEGORY TOTALS  
(I MEF, II MEF, III MEF, AND MARFORRES)**





### Corrosion Service Teams



### CST Locations

Camp Lejeune, NC	Cherry Point, NC
Camp Pendleton, CA	29 Palms, CA
K-Bay, HI	Okinawa, Japan

2 Reserve teams that travel CONUS

Organizational Level maintenance IAW TM-4795-12



### Corrosion Repair Facilities – Fixed facility

- Onsite blasting and repair of tactical vehicles and ground support equipment
- Located at LeJeune, Pendleton, Hawaii, and Okinawa
- Operation of CRF is dependant upon location (i.e. MARFOR, LOGCOM, CPAC)





### Corrosion Repair Facilities – Mobile Facility

- Provides Temporary On-site surface preparation and painting capability
- Used primarily at remote locations (i.e. reserves) and to supplement fixed-facility production (surge capability)





## Controlled Humidity Protection





## Vapor Corrosion Inhibitor (VCI) Covers



Six Con Fuel Pump Cover



MTVR Dash Cover



Generator Covers



HIMARS Cover

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# New Acquisition

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Logistics Vehicle System Replacement (LVSR)



High Mobility Artillery Rocket System (HIMARS)



Mine Resistant Ambush Protected (MRAP)

## New Acquisition



Medium Tactical Vehicle Replacement (MTVR)



Joint Light Tactical Vehicle (JLTV)



MTVR-Trailer (MTVR-T)

Materials /  
Vehicle  
Corrosion  
Testing

Production  
Audits

Field Surveys

Acquisition  
Wording



## Contract Wording

- Define required service life in operational environment
- Contractor must provide Corrosion Prevention Plan (CPP) during System Development and Design (SDD) phase
- Required testing of processes and products detailed in CPP (i.e. steel panel with CARC)
- Full system testing during LRIP - Combination of RAM and Corrosion Events to identify system capabilities
- Follow-on production audits and field surveys to ensure that contractor is following CPP
- DoD Series 5000.67 all ACAT 1 programs must form Corrosion Prevention Advisory Teams (CPAT)

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Accelerated Corrosion Test Facility



Splash Trough



Deep Water Fording Basin



Grit Trough



Mist Booth



Endurance Course Input



High Heat High Humidity

- 22 year corrosion assessment in 200+ days.
- Combination of RAM and Corrosion Events to identify system capabilities
- Corrosion deterioration matched to USMC operating environment



## Production Audits and Field Surveys

- Ensure all processes and produced detailed in CPP
- Contractor is required correct all deficiencies identified by Government inspection team
- Field inspection data may be linked to OEM production problem or be used for ECP / process improvement





## Mine Resistant Ambush Protected (MRAP) Vehicle Systems

### Schedule

- Completion of site visits Feb 2009
- Formed CPAT and oversaw Gov CPCP
- Finalize solution sets April 2009
- Develop field-level maintenance procedures Oct 2009

### Issues

- Availability delayed some site visits this Fall

### Direct Program Support for Corrosion Control

- Review of current MRAP variants for corrosion issues
- Review of OEMs and Tier-1 suppliers process for corrosion control initiatives
- Develop solutions for rebuild / block upgrade
- Develop field-level maintenance procedures

### Sponsor – JPO MRAP

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### Ad-hoc Member of Acquisition Team for Corrosion Control

- Provided corrosion control contractual wording
- Coordinated with US Army TARDEC on corrosion acquisition language
- Providing cursory guidance on corrosion control in an on-call / as-needed basis

### Joint Light Tactical Vehicle (JLTV)

#### Schedule

- TBD

#### Issues

- During TD Phase less emphasis being placed on corrosion control
- CPAT not yet formed and CPC Plan has not yet been developed
- Lack of consideration at this phase may result in corrosion deficiencies / difficulties during prototyping and LRIP

#### Sponsor – PM JLTV

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## Logistics Vehicle System Replacement (LVSR)

### Schedule

- Completion of road test mid-March 2009

### Issues

- Oshkosh raised issue with test severity (claims over-aggressive)
- Working with PM office to review contractual requirements

### Direct Program Support for Corrosion Control

- Oversight of corrosion / durability road test at Aberdeen Test Center (ATC)
- Review of test monitoring data
- Post-test inspections every 8 cycles
- Evaluation of corrosion-related failures
- Review of Oshkosh analysis and solutions with recommendations

### Sponsor – PM LVSR

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## Expeditionary Fighting Vehicle (EFV)

### Schedule

- Completed review of Government CPAT and CPCP
- Reviewed designs and bill of materials

### Issues

- Delivery of next prototype systems has not yet been determined

### Ad-hoc Corrosion Control Support to Program

- Act in advisory role to PM and GD corrosion engineers
- Provide input during CDR
- Support corrosion control evaluation of next prototype systems

### Sponsor – PM AAA

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### Corrosion Control Support to Program (planned)

- Act in advisory role to PM on corrosion engineers
- Act as technical lead for CPAT
- Develop government CPC Plan
- Evaluate manufacturer's design(s) for corrosion control
- Review ECPs

## Marine Personnel Carrier (MPC)

### Schedule

- TBD

### Issues

- CDR scheduled for Fall 2008, no notification for revised schedule
- Delivery of next prototype systems has not yet been determined

### Sponsor – PEO Land Systems

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### On-call / Sustainment Corrosion Control Support to Program

- On-call corrosion support
- Develop maintenance / sustainment procedures for corrosion control of LAVs variants

## Light Armored Vehicle (LAV)

### Schedule

- TBD

### Issues

- N/A

### Sponsor – PM LAV

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## G/ATOR

### Schedule

- Reviewed materials used in construction and provided recommendations to program office

### Issues

- Trailer is being redesigned

### On-call / Sustainment Corrosion Control Support to Program

- On-call corrosion support
- Determine testing requirements
- Develop maintenance / sustainment procedures for corrosion control

### Sponsor –

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## Medium Tactical Vehicle Replacement (MTVR)

### Schedule

- Base production complete

### Issues

- N/A

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### On-call / Sustainment Corrosion Control Support to Program

- On-call corrosion support
- Act in advisory role to PM on corrosion and materials issues as identified
- Support corrosion maintenance actions

### Sponsor – PEO Land Systems

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### Direct Program/Project Support for Materials and Corrosion Control

- Provide review of test articles at NATC
- Make recommendations for mitigation and prevention of corrosion
- Review production facilities and make recommendations for process improvement
- Provide recommendations for CST process services

## MTVR-Trailer

### Schedule

- Feb. 2008 – Site Visit to NATC for review of test articles
- April 2009 – Site visit to CMDC to review production
- Summer 2009 – Corrosion test and evaluation

### Program Officer: Laverne Rodriguez

CMDC POC: Victor McIntyre

### NSWCCD POC

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LSV



PM

## Internally Transportable Vehicle (ITV)

### Schedule

- Production inspection and site visit to AGI – Nov. 10
- Test article evaluation at NATC - Nov. 20
- Trip report - Dec 19th

### Issues

- Improper painting practices, poor health/ environmental practices, no quality control measures
- Poor frame design for accumulation of dirt, lack of lubrication for tie-downs and hinges, poor paint coverage

### Direct Program/Project Support for Materials and Corrosion Control

- Site visit to production facility
- Assessment of test article
- Recommendations for process improvement
- Recommendations for CST practices

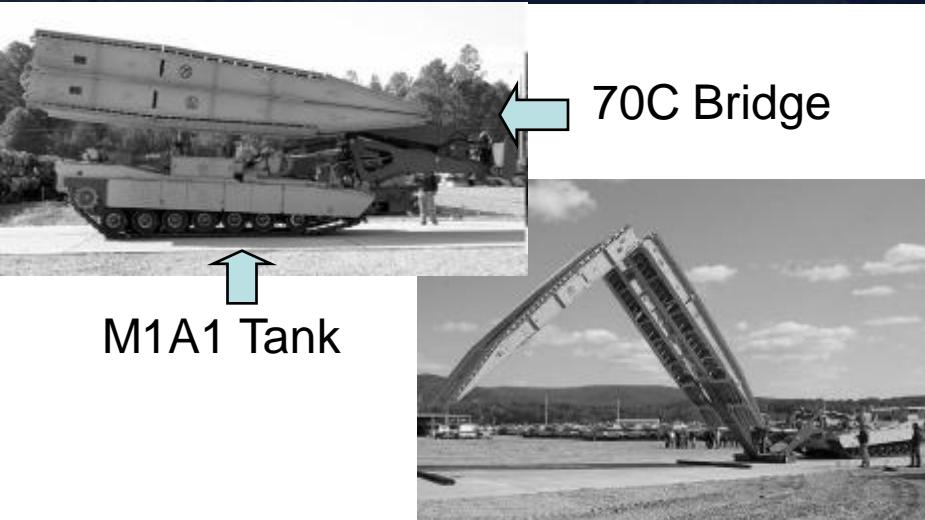
Program Officer: Greg Cochran

AGI POC: Keith Davis

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## Joint Assault Bridge (JAB)

### Schedule

- Test article evaluation – Dec. 16
- Production inspection
- Trip report

### Issues

- TBD

### Direct Program/Project Support for Materials and Corrosion Control

- Assessment of test article
- Recommendations for process improvement
- Recommendations for CST practices

Program Officer: Percy Kirklin

Northrup Grumman POC: Beth Lee

ATC POC: Robert Nixon

NSWCCD POC

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## Heavy Combat Equipment (HCE) and Material Handling Equipment (MHE)

### Schedule

- N/A

### Issues

- Identification of corrosion control systems no longer priority at John Deere
- Need to re-engage OEM to ensure appropriate emphasis is being placed on corrosion control

## Ad-hoc Corrosion Control Support to Program

- On-call corrosion support
- Reviewed of corrosion control systems on John Deere MCT and TRAM systems
- Recommendations on improvements for existing systems
- Development of fleet corrosion control maintenance / sustainment procedures
- Supported identification of materials and testing for corrosion control systems for use by John Deere

### Sponsor – PG-15

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### Containers



### Generators



### Environmental Control Units



Direct Program/Project Support for Materials and Corrosion Control

- Assessment of test article
- Recommendations for process improvement
- Recommendations for CST practices

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# **Research and Development Engineering**



## Corrosion Prevention Products and Materials Program



New Product



Laboratory and Static  
Testing



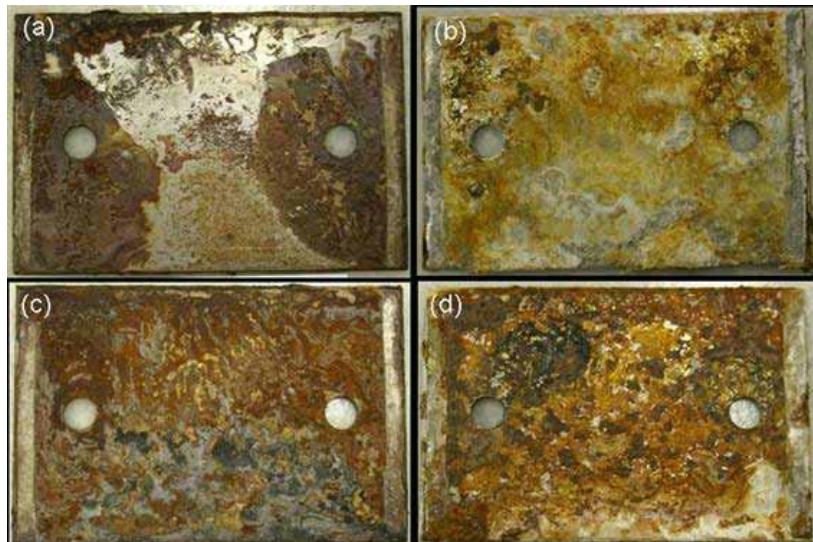
Field Demonstration  
Testing





# Corrosion Prevention Products and Materials Program

- CPAC approved Zinc-Rich Primer (ZRP) for use with CARC system
- Approved Solvent Borne CARC (MIL-PRF-53039 Type II)
- Approved Bedliner coating (Tough Coat)





## Wash Rack – Detergents

- CPAC program has built two wash racks at III MEF Hawaii (12<sup>th</sup> Marines and CSSG-3)
- Currently detergents or corrosion inhibitors are not allowed to be used due to environmental restrictions
- CPAC in progress of Testing detergents for use in oil water separators





### Performance Evaluation of CPCs Using Corrosion Sensors – Laboratory and Field Studies

#### Background:

- Condition-based maintenance to optimize maintenance intervals.
- Corrosion sensor measures electrochemical impedance across two embedded wires.
- Drop in impedance indicates failure of coating.
- Signal is transmitted through wireless platform to a web portal.



#### Results:

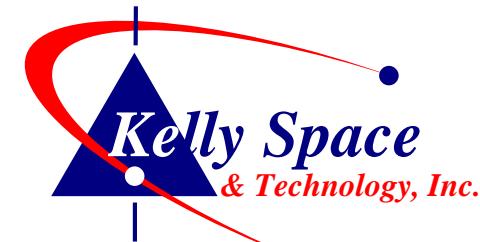
- Laboratory tests showed that the changes associated with coating failure were more pronounced at lower measurement frequencies.
- The sensitivity of the sensor is linearly dependent on the performance of the CPC.
- Changes of impedance parameters measured during the wet part of the exposure cycle correlated well with visual observations – recovery was observed in some cases during the dry part of the cycle.
- Increasing the number of wires embedded into the sensor did not improve its sensitivity.

#### Conclusions:

- Impedance based coating degradation sensors can be successfully used to detect coating failure and assess the performance of CPCs in coastal environments.
- Field testing of the sensor packages showed that it is feasible to collect and wirelessly transmit temperature, relative humidity and impedance data using motes-based sensor technology.



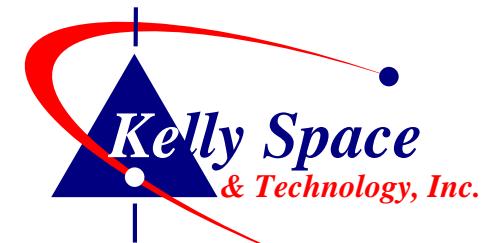
## Portable Laser De-coating System



- Portable Laser De-Coating System
  - Next generation coating and corrosion removal technology developed and demonstrated under USMC CPAC program
  - High efficiency, modular CO2 LASER design enables easy output power scale up
  - 10.6nm CO2 LASER wavelength ideal for metallic and composite substrates due to low thermal energy absorbance
  - Environmentally friendly – tons of hazardous media waste eliminated every year
  - Easily deployable or incorporated into plant refurbishment processes
  - Demonstrated efficacy of utilizing Portable CO2 LASER system by removing CARC, various forms of corrosion, and conformal coating at USMC Maintenance Center Barstow



## Portable Laser De-coating System





# Appendix to DoD Corrosion Guidebook on Ground Vehicles

- Corrosion Prevention and Control Planning Guidebook provides acquisition guidance for ACAT 1 acquisition programs
- Spiral 3 (current version) provides system-specific guidance through appendices
- Currently only Aerospace and Navy Ships and Submarines had appendices
- Service and industry SMEs (including CPAC were approached) to develop an appendix specific to ground systems

vehicle corrosion & coatings issues



- Appendix is currently in its 5<sup>th</sup> draft revision
- Appendix has combined USMC and US Army corrosion recommendations into a set of unified requirements
- Appendix has incorporated results of recent studies, test methodology development efforts and the current state-of-the-art in vehicle corrosion control

Final draft anticipated by DoD Corrosion Conference (10-14 August 2009)



## Training



SPRAY TECHNIQUE ANALYSIS AND RESEARCH FOR DEFENSE

Hands-on Painter Training for the U.S. Armed Forces

- STAR-4D has been training Military personnel at UI campus in Waterloo, IA for CARC painting
- STAR-4D will provide equipment and classroom materials to USMC Depots (Barstow and Albany).
- Selected USMC personnel will be trained by STAR-4D to be authorized instructors of class First USMC class expected in April 09

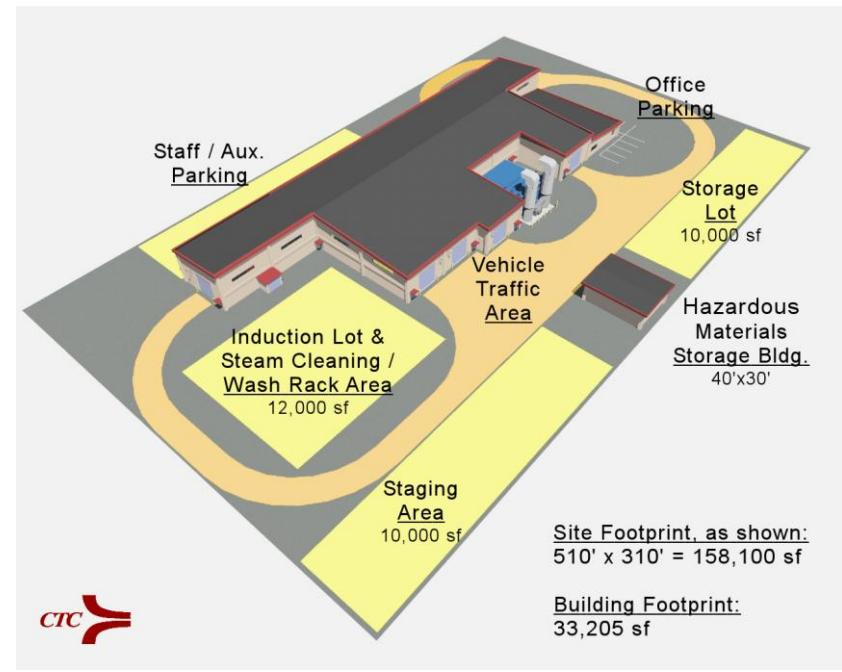




### CPAC PROGRAM SUPPORT TO USMC GUAM TRANSITION

#### Status

- Established a line of communications with the relevant planning agencies.
- Completed a capabilities and baseline assessment of the CRF aboard Camp Kinser.
- Evaluated the proposed vehicle and equipment breakdown for each location.
- Identified processes, equipment, and materials essential for startup of new CRFs and communicated to the appropriate planning agencies.
- Developed transition recommendations, including proposed CRF layouts and initial cost estimates.



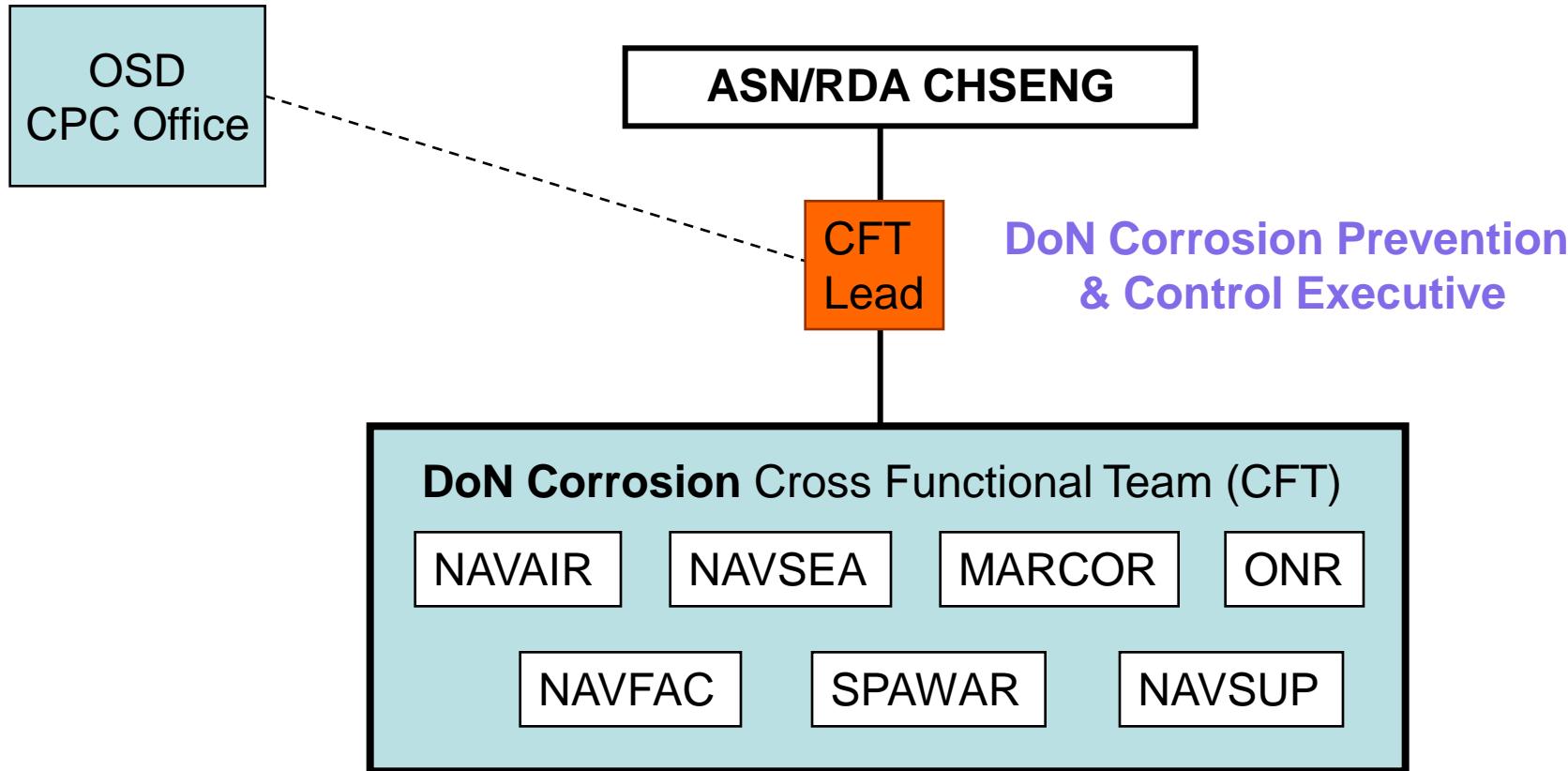
Proposed Guam CRF

#### Future

- Continue communications with planning/funding sources to ensure capabilities are maintained in the CRF designs
- Prepare construction and start-up recommendations for the new CRFs.
- Assist with the final planning and construction processes.
- Provide oversight to the construction of the new CRFs.
- Provide direction and oversight to the start-up of the new CRFs.



## Navy/Marine Corp Corrosion Team



National Defense Authorization Act for Fiscal Year 2009  
Sec. 903, signed 14 Oct 2008, & 10 USC 2228



### Technical Manuals

CPAC RELATED TECHNICAL MANUALS		
SHORT TITLE	TITLE	DOCUMENT TYPE
TM-4795-12/1	Organizational Corrosion Prevention and Control Procedures for USMC Equipment: April 2002	Electronic Publication
TM-4795-34/2	Corrosion Prevention and Control Rustproofing and Underbody Coating Procedures for Tactical Vehicles, Trailers, and Engineer Equipment: September 1999	Electronic Publication
TM 3080-50	Corrosion Control Procedures Depot Maintenance Activities for Marine Corps Equipment: December 1989	Electronic Publication
TM-4750-OD/1A	Painting and Registration Marking for Marine Corps Combat and Tactical Equipment: November 2004	Electronic Publication
TM 4750-OD/2	Camouflage Paint Patterns	Electronic Publication

# MARINE CORPS SYSTEMS COMMAND

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## CPAC Website

• Maintained by CPAC Prgm Mngr

• Provides USMC user with a source of CPAC related information

• [www.marcorsyscom.usmc.mil/cpac](http://www.marcorsyscom.usmc.mil/cpac)

Corrosion Prevention and Control (CPAC) - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites Media Mail My Yahoo! My Personals Shopping Games Nuc Sign In

Address http://www.marcorsyscom.usmc.mil/cpac/default.asp

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United States Marine Corps Corrosion Prevention and Control (CPAC)

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Mission: To establish an effective CPAC program to extend the useful life of all Marine Corps tactical ground and ground support equipment, and to reduce maintenance requirements and associated costs through the identification, implementation, and, if necessary, development of corrosion prevention and control products, materials, technologies, and processes. The use of these technologies and processes will repair existing corrosion damage and prevent, or at least significantly retard future corrosion damage on all Marine Corps tactical ground and ground support equipment.

For more information, contact [CPAC](#).

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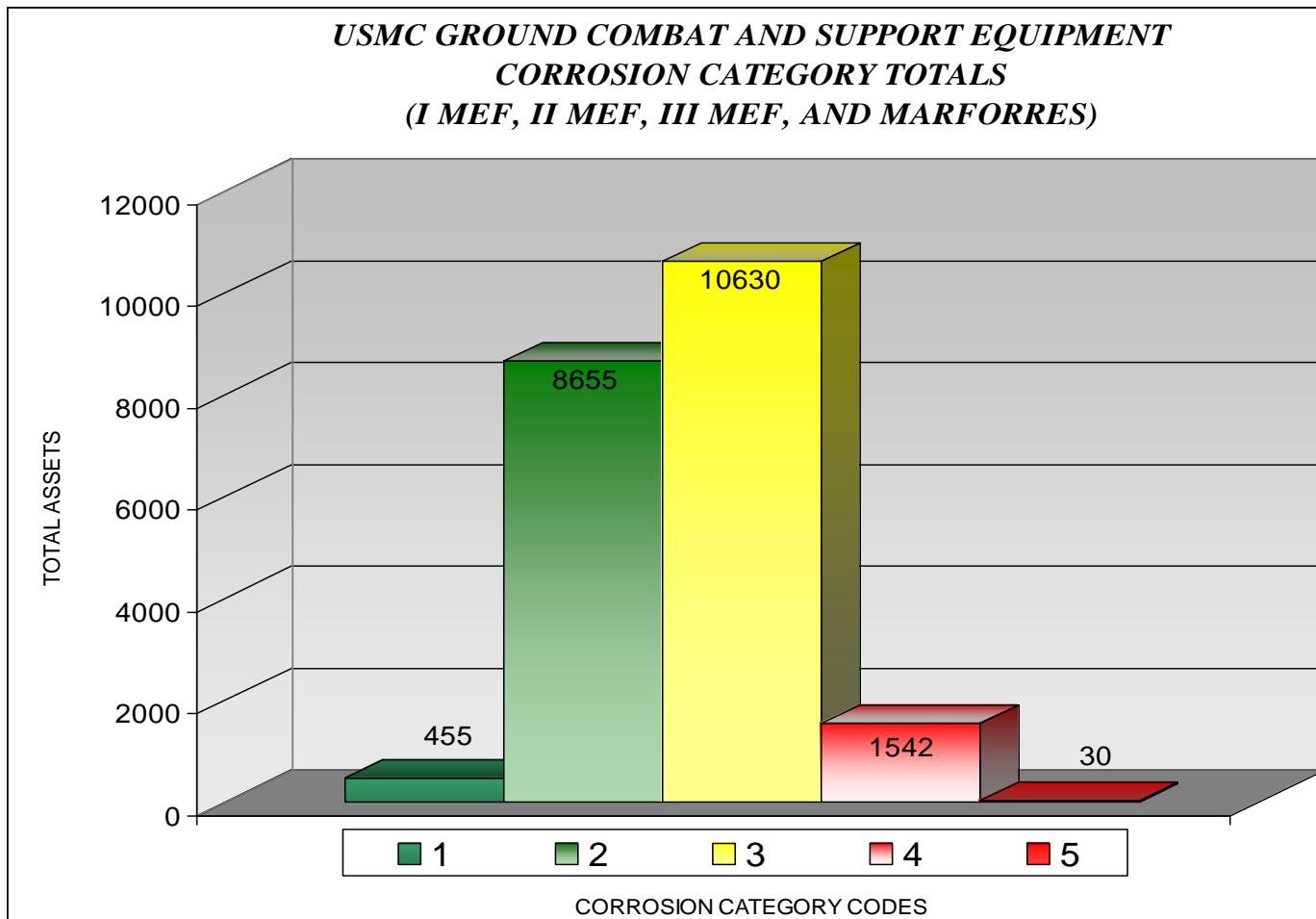
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2/20 PM



### Where we were Three Years Ago

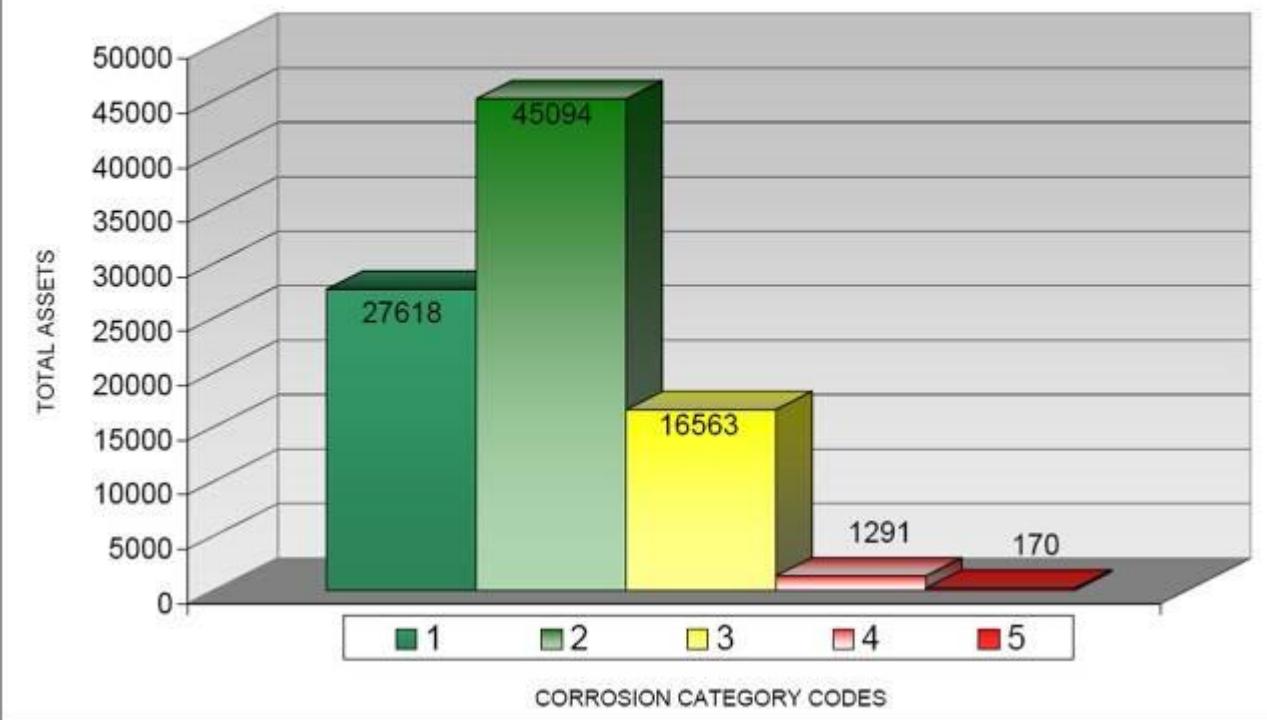


(21,312 Assets Serviced and Assessed)



### Where we are today

*USMC GROUND COMBAT AND SUPPORT EQUIPMENT  
CORROSION CATEGORY TOTALS  
(I MEF, II MEF, III MEF, AND MARFORRES)*



(54,646 Assets Serviced and Assessed)